

SPROUT SUPPRESSION 2020

**Sprout suppression – a technical
viewpoint**

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Sprout Control Options

- Variety selection
- Low storage temperatures
- Product application
 - In-field
 - In-storage
 - Spray application at packing shed for fresh market



Major Sprout Control Products in the US

- Chlorpropham (CIPC)
- Maleic hydrazide (MH) – field applied
- Diisopropylnaphthalene (DIPN; Amplify)
- Dimethylnaphthalene (DMN; 1,4-sight)
- 3-decen-2-one (SmartBlock)
- Clove oil (Biox C; Sprout Torch)- organic
- *Mint oil or other essential oils- organic

Sprout Control Programs

- CIPC based
 - Thermal (forced air storage; recirculation) and/or spray application
 - May have other products in mix or sequence; reduced rates
- No CIPC
 - None, sole or multiple product programs
 - Organic, non-CIPC markets, avoid contamination of storage
 - Seed potato options
- Product for sprout control and to blacken eyes for retail fresh market
 - Thermal or spray



CIPC

- In-storage (1° sprout inhibitor used)
 - apply as thermal fog – *temperature, method of application and equipment are applicator dependent*
 - initial application early, before pile settles, after wound healing
 - depending upon cultivar, temperature and duration in storage, typically apply 15 to 25 ppm; retreat only if necessary (~10-20 ppm)
- Packing sheds
 - Spray (EC; up to 10 ppm) formulation applied to washed potatoes

Table 1. CIP C residue (ppm) in the animal storage with different CIP C application techniques.

	Building 1		Building 2	
	First application	Re-application	First application	Re-application
Product	CIPC 98%	None	CIPC 98%	CIPC 98%
Rate	1:400; 624lbs	0	1:400; 615lbs	1:500; 178 lbs*
Application date	11/2/13	Na	11/1/13	4/30/14
Reversed fan Y or N	No	Na	Yes	No
Fan speed	"Low"	Na	"Very low"	No circulation
Application temperature	600°F	Na	900°F	-
Sampling date	12/5/13	5/29/14	12/5/13	5/29/14
Mean residue (n=18) ppm	11.8	1.8	5.3	2.8
Mean Top (n=9) ppm	12.8	0.6	5.6	0.9
Mean Down 1' (n=9) ppm	10.8	3.0	5.0	4.8
LSD 0.05	1.1	1.4	NS	2.0
Mean "Near" (n=6)^	10.7	0.9	4.5	0.7
Mean "Mid" (n=6)	12.0	3.3	3.6	2.5
Mean "Far" (n=6)	12.7	1.2	7.9	5.3
LSD 0.05	1.4	1.7	0.9	2.5
Mean Near Top (n=3)	11.0	0.4	4.1	0.4
Mean Near Dig (n=3)	10.3	1.4	4.8	0.9
Mean Mid Top (n=3)	13.0	0.9	4.7	0.9
Mean Mid Dig (n=3)	11.0	5.7	2.4	4.2
Mean Far Top (n=3)	14.3	0.5	7.9	1.4



CIPC update in United States



- Chlorpropham
 - US MRL (maximum residue level) 30 ppm
 - 2009 USDA Pesticide Data Annual Summary: CIPC found in 80% (596/744) of samples and residue levels of 0.01 to 23 ppm. **Mean detection 2.5 ppm.** All below 30 ppm.
 - Industry commissions sampling for residues.
 - Industry looking for means to reduce rates and residues, utilize alternative chemistries.
 - Applaud
 - Potato Industry CIPC Stewardship Group – “Be CIPC Compliant”



CIPC
Stewardship
=
Global Priority



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Maleic Hydrazide applied in field



Russet
Burbank

July

Early MH

Non-registered
compound

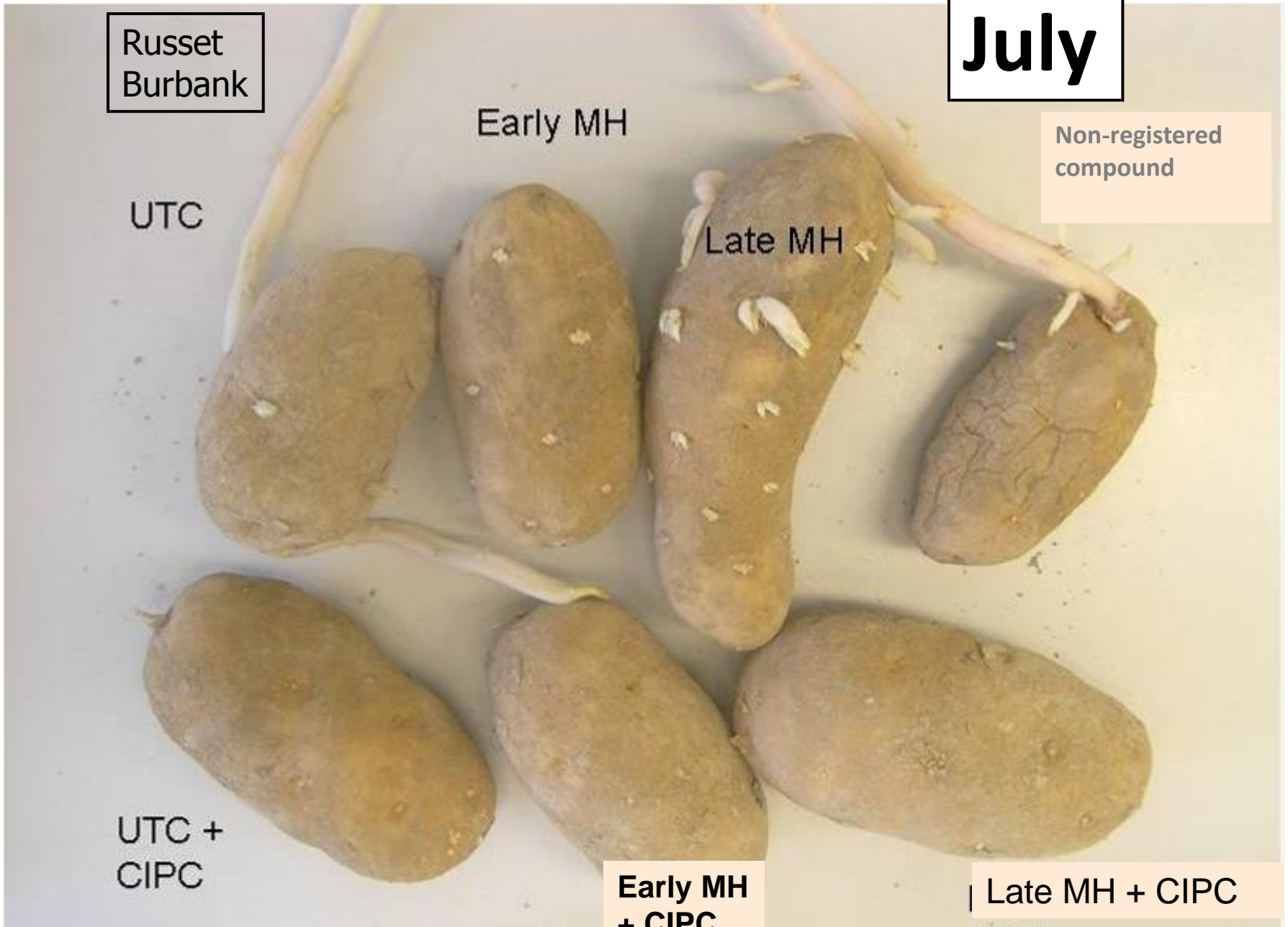
UTC

Late MH

UTC +
CIPC

Early MH
+ CIPC

| Late MH + CIPC

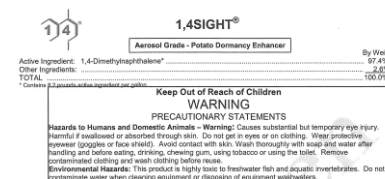


Maleic hydrazide

- Effective for severely retarding sprout growth
- Extend dormancy break by approximately 30 days
- Timing important
- Good for aggressive sprouting varieties
- Effective sprout control programs
 - Alone
 - MH-30 followed by CIPC or other sprout inhibitor in storage

Naphthalene based products

- Diisopropylnaphthalene (DIPN)
 - Typically, thermally applied in combination with CIPC
- Dimethylnaphthalene (DMN)
 - No residue issue; exempt from tolerance
 - Thermally applied alone or with CIPC program
 - Aerosol canisters for shipping containers
 - Thermal application to seed (30 days before planting)



3-decen-2-one

- Chemically synthesized food additive. No residue tolerance established because regulated as a food additive
- Apply thermally at pre- or at- visual initiation of sprouting or if advanced sprouting- damage sprouts.
- Long-term sprout control with 1 to 3 applications depending upon storage temperatures and variety
- Higher storage temperatures; aggressive sprouting varieties may need additional applications
- Blackens eyes; damage immediately observed; odor
- Integrate into effective sprout control programs that may include CIPC, MH, others



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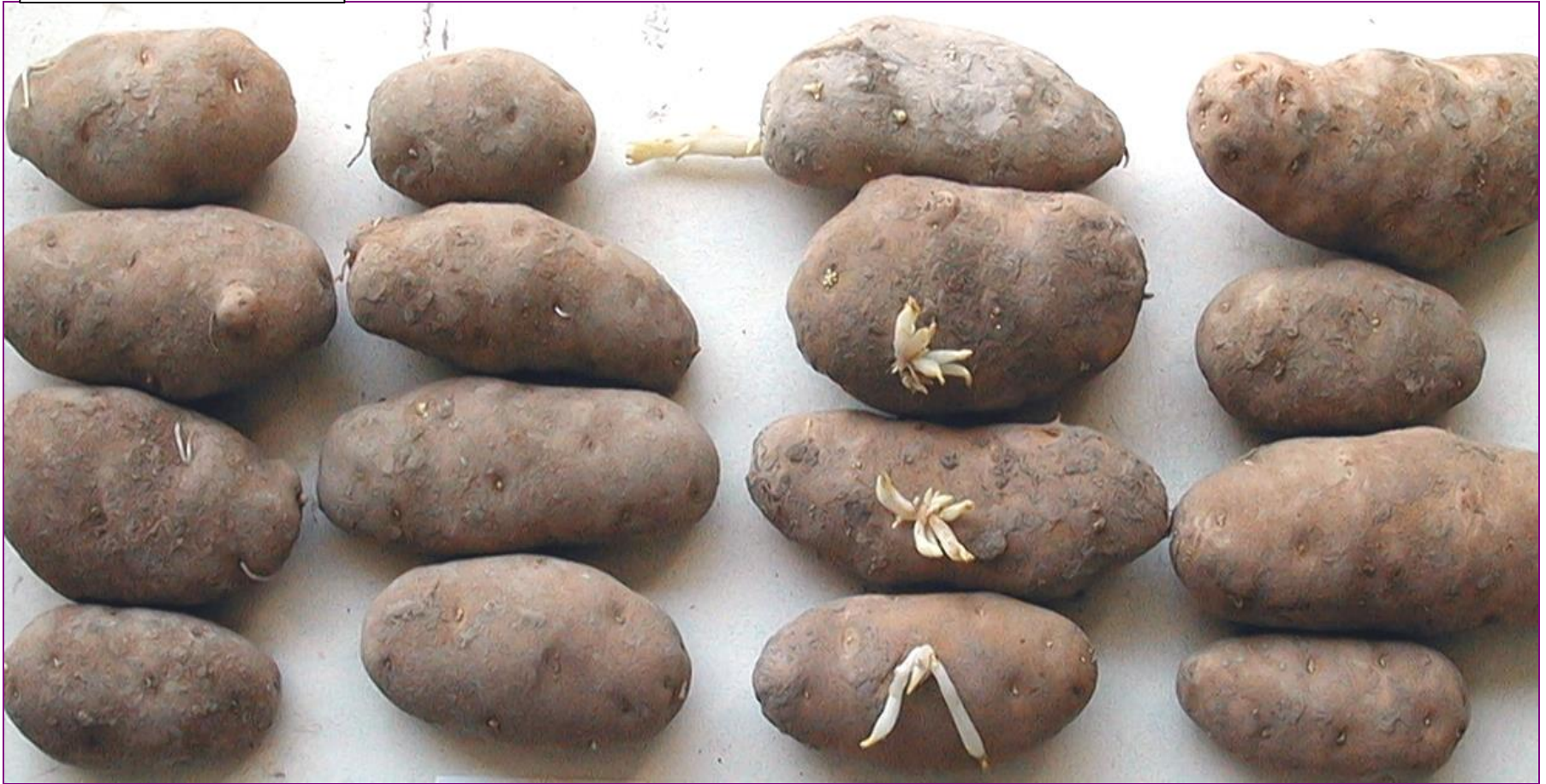
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Essential Oils: Clove Oil; Mint Oil

- Mode of action: physically damages sprout
- Reapplication is necessary for long-term control
 - 50 to 100 ppm each treatment
 - Dependent upon variety and storage temperature
 - ~2 to 6 week intervals
- Blackens eyes; Odor
- Effective sprout control programs
 - Alone (organic approved)
 - MH plus clove oil (no CIPC)
 - CIPC plus clove oil= true mix or sequence
 - Spray application at packing shed



Taste difference



Spearmint Peppermint Untreated CIPC

Russet Burbank after 9 months in 7.2°C storage
(8 applications of mint oil)





Idaho Research on Sprout Suppression

- True mixtures with CIPC: Clove oil, 3-decen-2-one, Canola oil, Peppermint oil
- Liquid versus solid CIPC
- Other alternatives: Pelargonic acid (newly registered in US), sagebrush oil, rosemary oil, muna oil, imazamox, harpin protein, salicylic acid, jasmonic acid, hydrogen peroxide, irradiation, and many others
- Temperature of application, rate, applicator type, sequence, recirculation time, corrosion, taste, processing quality, disease, phytotoxicity, etc.



Some Retailer's Objective:
***to blacken eyes resulting in customer
perception that no sprouting will occur***



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No CIPC



Thermal Aerosol CIPC in storage

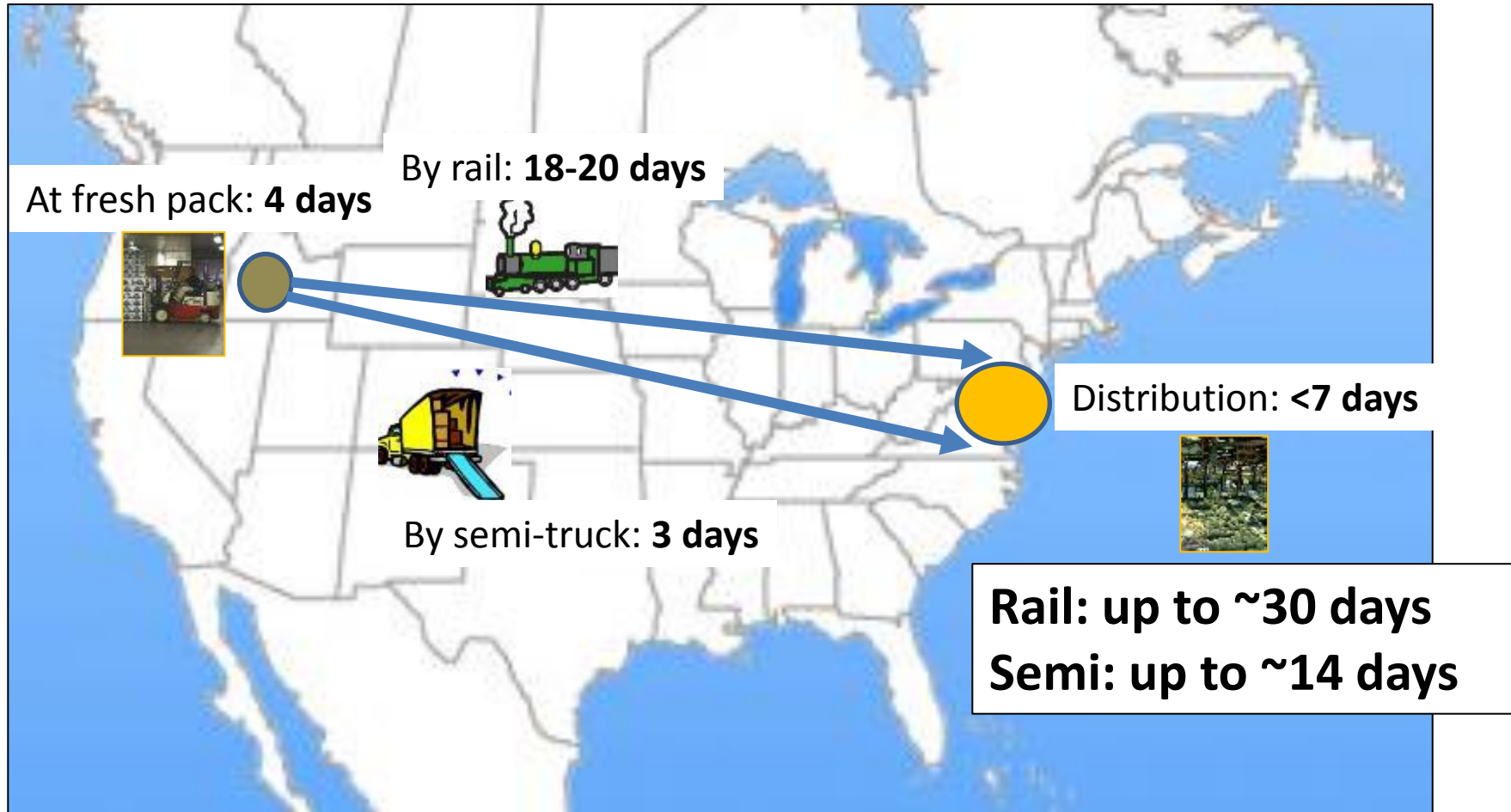


Thermal Aerosol CIPC plus spray
CIPC



Thermal Aerosol CIPC plus spray
CIPC and clove oil

Time to Reach Customers

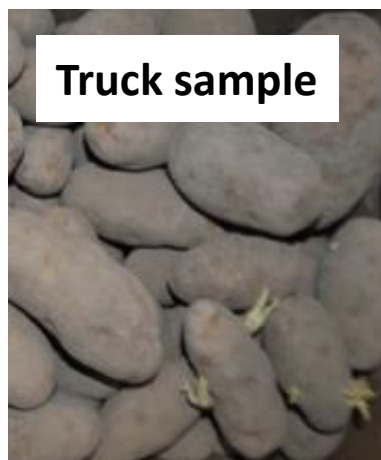


Collection from truck, after washing and after CIPC spray application on sprout development (g/tuber) after 30 days at 15.5°C.

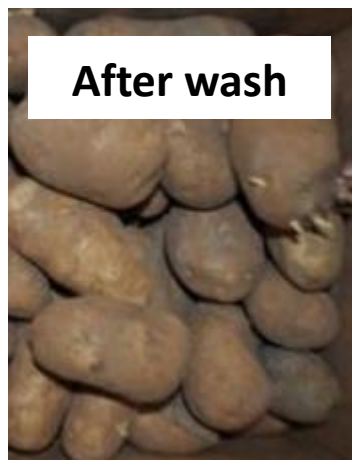
Sampling date	Dec Storage A	Jan Storage B	June Storage C	June Storage D
Truck	0	0.03	0.15	0.07
After wash	0	0.01	0.29	0.53
After CIPC spray	0	0	0	0

June photos

After 30 days at
15.5°C



Truck sample



After wash



After CIPC spray

Remove 0.8 -2.5 ppm CIPC

Add 0.9 -1.9 ppm CIPC



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Export: Time to reach customers



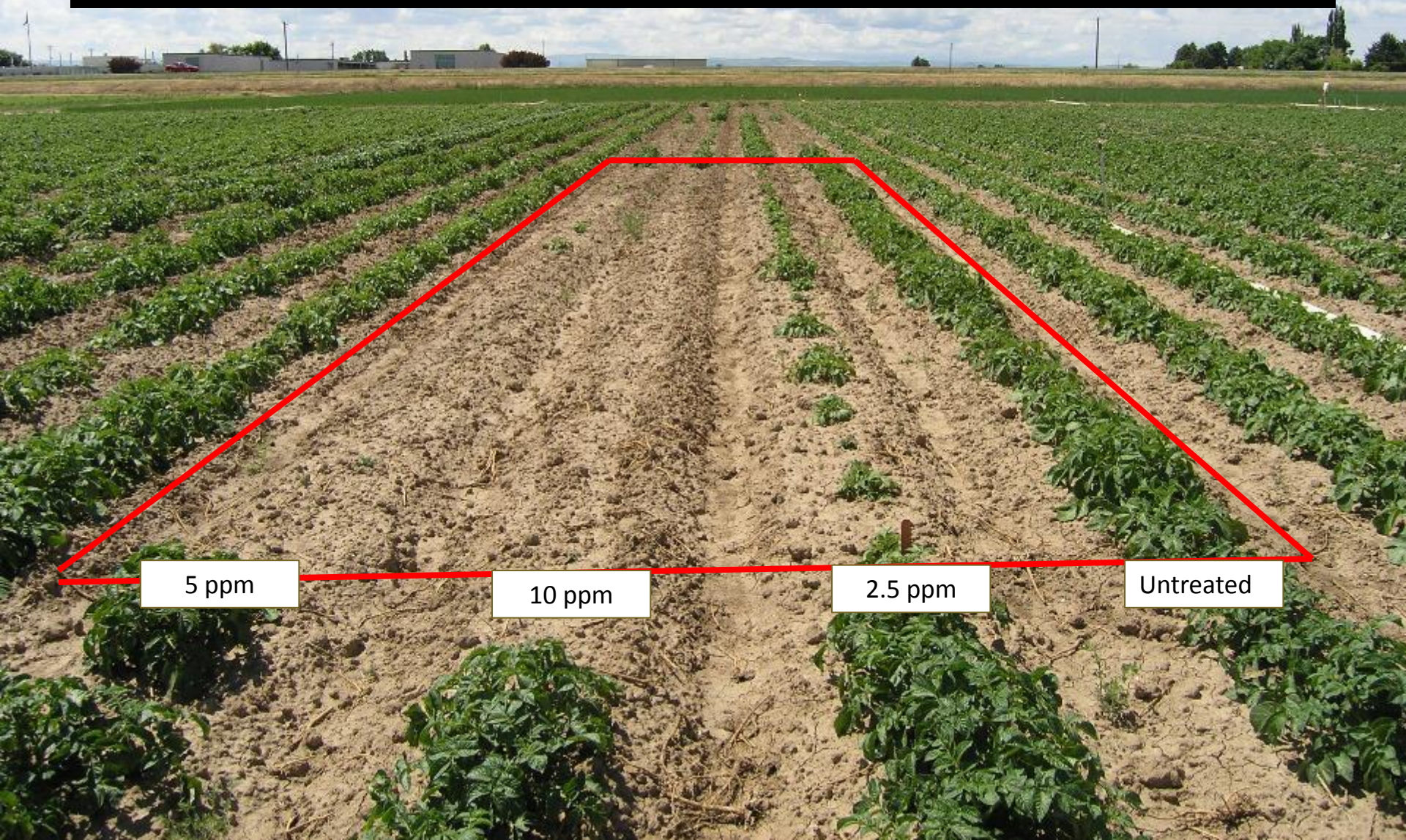
Ship and port: ~21
to 45 days



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CIPC contamination on seed or CIPC as phytosanitary tool



Seed Exposure to CIPC

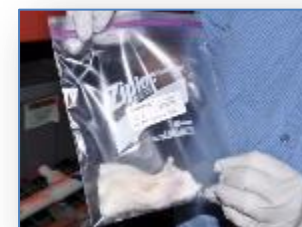


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Swabbing for CIPC residues (ppm)

	Treated Bins	Pre-application <i>September</i>	After application <i>December</i>	After cleaning <i>August</i>
Bin 1	Both years prior	18	240	3.4
Bin 2	Both years prior	35	1,100	2.7
Bin 3	Both years prior	19	320	1.6
Bin4	Only 1 year prior	10	210	3.7
Bin5	Untreated	0.9	-	0.2



Window of no-CIPC application

- Cultivar, season and temperature dependent
- First 1-3 months after harvest
 - Need to know market and when potatoes will be moved
 - Risk of plans changing
- Maleic hydrazide for process potatoes – some sprouting is tolerated
- Use of alternatives



Sprout Suppression Options for Organic Potatoes

- Cultivar selection – long dormancy, good storability
- Store as cold as possible for end use
- Thermal applications of clove oil
- Spray application of clove oil EC formulation at packing shed
- Process early and store as frozen or manufactured product or market with stipulation that need to be consumed soon



Current Major Sprout Control Options

- Variety selection and cooler temperatures
- Maleic Hydrazide – field application; 30 day longer dormancy; slow sprout growth
- CIPC – highly effective
- DMN and DIPN – mild sprout suppressants; use in combination with CIPC
- Clove oil- organic; mix with CIPC; blackens sprouts
- 3-decen-2-one – alone or in combination with others. Blackens sprouts
- Development of integrated programs
- New chemistries





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